

CLAIMS

1. A method of making a superconducting structure, comprising:
depositing a metal alkoxide on a surface of a metal; and
hydrolyzing the metal alkoxide on the surface to form a pinhole-free film;
wherein the metal is a superconductor.
2. The method of claim 1, wherein the metal is a ceramic superconductor.
3. The method of claim 2, wherein said film surrounds said superconductor.
4. The method of claim 1, wherein the metal is YBCO.
5. The method of claim 1, further comprising repeating the depositing and hydrolyzing.
6. The method of claim 1, further comprising rinsing the metal alkoxide on the surface.
7. The method of claim 1, further comprising rinsing the pinhole-free film.
8. The method of claim 1, wherein the metal alkoxide is a zirconium or hafnium alkoxide.
9. The method of claim 1, wherein the metal alkoxide is $Zr_4(OPr^n)_{16}$ or $Hf_4(OPr^n)_{16}$.
10. The method of claim 2, wherein the metal alkoxide is $Zr_4(OPr^n)_{16}$ or $Hf_4(OPr^n)_{16}$.
11. A superconducting structure, prepared by the method of claim 1.

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12. A superconducting structure, comprising:
 - a ceramic superconductor; and
 - a pinhole-free film on the ceramic superconductor.
 13. The superconducting structure of claim 12, wherein the film comprises zirconium or hafnium.
 14. The superconducting structure of claim 12, wherein the ceramic superconductor is YBCO.
 15. A tunnel junction, comprising:
 - the superconducting structure of claim 12; and
 - a second metal on the pinhole-free film.
 16. The tunnel junction of claim 15, wherein the second metal is a superconductor.
 17. A compound of formula (I)
$$M_4(OPr^n)_16 \quad (I);$$
wherein M is zirconium or hafnium; and
wherein the purity of the compound is at least 97% as measured by NMR spectroscopy.
 18. The compound of claim 17, wherein the purity of the compound is at least 99% as measured by NMR spectroscopy.
 19. The compound of claim 17 wherein M is zirconium.
 20. A method of making the compound of claim 17, comprising:
 - distilling $M(OPr^n)_4$.
 21. A superconducting structure, comprising:
 - a ceramic superconductor; and
 - a metal oxide coating on the ceramic superconductor;

wherein the electronic structure of the ceramic superconductor is unchanged when the superconducting structure is stored in air at 25°C at 100% humidity for at least one week.

22. The superconducting structure of claim 21, wherein the electronic structure of the ceramic superconductor is unchanged when the superconducting structure is stored in air at 25°C at 100% humidity for at least one month.

23. The superconducting structure of claim 21, wherein the electronic structure of the ceramic superconductor is unchanged when the superconducting structure is stored in air at 25°C at 100% humidity for at least six months.

24. The superconducting structure of claim 21, wherein the electronic structure of the ceramic superconductor is unchanged when the superconducting structure is stored in air at 25°C at 100% humidity for at least one year.

25. The superconducting structure of claim 21, wherein the ceramic superconductor is YBCO.

26. The superconducting structure of claim 21, wherein the metal oxide coating comprises zirconium or hafnium.

27. The superconducting structure of claim 25, wherein the metal oxide coating comprises zirconium or hafnium.

28. A method of making a metal structure, comprising:
depositing a metal alkoxide on a surface of a metal; and
hydrolyzing the metal alkoxide on the surface;
wherein the metal alkoxide is a compound of formula (I):



and M is zirconium or hafnium.

29. The method of claim 28, wherein the metal is a superconductor.
30. The method of claim 28, wherein the metal is a ceramic superconductor.
31. The method of claim 28, wherein the metal is YBCO.
- 5 32. The method of claim 28, further comprising repeating the depositing and hydrolyzing.
33. The method of claim 28, further comprising rinsing the metal alkoxide on the surface.
- 10 34. The method of claim 28, wherein the hydrolyzing of the metal alkoxide forms a metal oxide on the surface.
35. The method of claim 34, further comprising rinsing the metal oxide on the surface.
- 15 36. A metal structure, prepared by the method of claim 28.
37. A metal structure, prepared by the method of claim 34.
38. A tunnel junction, comprising:
the metal structure of claim 37; and
a second metal on the metal oxide.
39. The tunnel junction of claim 38, wherein the metal is a superconductor.
- 20 40. The tunnel junction of claim 38, wherein the second metal is a superconductor.
41. A method of making a superconducting device, comprising:
forming a superconducting structure by the method of claim 1;
and

forming a superconducting device from the superconducting structure.

42. A method of making an electronic device, comprising:
forming a metal structure by the method of claim 28; and
forming an electronic device from the metal structure.